Response to Anonymous Referee #1 Interactive comment on “Image analysis for measuring stratigraphy in sand-gravel laboratory experiments” by C. Orrú et al.

The authors would like to sincerely thank the anonymous reviewer for the clear and constructive comments which will certainly be helpful to improve the manuscript. In the following we respond to the proposed revisions and comments.

1. We will add the proposed examples of local sorting effects such as bars and bends. These examples will be included in the introduction.

2. The grain size distribution can be considered as composed of three discrete size fractions. The following are the grain size intervals of the three grain size fractions:

   Fine size fraction 1: 0.80-1.25 mm;

   Medium size fraction 2: 1.70-2.50 mm;

   Coarse size fraction 3: 3.15-5.60 mm.

   We considered these fractions as having negligible overlap since the result of the sieve analysis, done to characterize the grain size distribution, indicated only a slight overlap of 1-2% between medium fraction 2 and coarse fraction 3 (Figure 2). The same results were obtained in the case of the painted fractions (Figure 2). As mentioned in the paper the non-overlapping fractions were chosen to facilitate the sieve analysis, which is required to evaluate the image analysis technique.

   The image analysis method was developed to compare future experimental data with the results of models such as a surface-based transport model (i.e. Wilcock & Crowe 2003), a sediment continuity model for mixed sediment (i.e. Hirano 1971, Ribberink 1987, Blom et al 2008), which require information on the volume fraction content for a range of grain sizes present on the bed. This explains why we do not measure individual grain sizes but rather measure the fraction content of a certain grain size fraction. We will add this information to the manuscript.

3. The densities of the original and the painted grain size fractions were measured before the experiments. An hydrostatic balance was used to carry out the measurements. We

noticed a slight decrease in mass density for the 3 grain size fractions due to the painting:

Original sediment

- Fine size fraction 1 = 2,61 g/cm^3
- Medium size fraction 2 = 2,61 g/cm^3
- Coarse size fraction 3 = 2,60 g/cm^3

Painted sediment

- Fine size fraction 1 (Blue) = 2,59 g/cm^3
- Medium size fraction 2 (Red) = 2,56 g/cm^3
- Coarse size fraction 3 (Yellow) = 2,55 g/cm^3

This slight decrease we considered acceptable. We will add this information to the paper.

4. The advised literature on size mapping will be included and discussed in the introduction.

Minor revisions and comments:

1) We thank the reviewer for pointing out the incorrect use of the term "stratigraphy". We will use the proposed term "size stratification".
2) We will rephrase P977 lines 21-25.
3) The idea of replacing the sediment and continuing the experiment is certainly valid only when sampling restricted areas of the flume (for example 30 cm x 30 cm) and definitely not feasible when sampling a large part of the deposit such as shown in Figure 18. We will clarify the text.

References

Blom, A., Ribberink, J. S., Parker G.: Vertical sorting and the morphodynamics of bed form-dominated rivers: A sorting evolution model, J. Geophys. Res., doi:10.1029/ 2006JF000618, 2008.

Hirano, M.: River bed degradation with armouring, Trans. Jpn. Soc. Civ. Eng., 3, 194– 195, 1971.

Ribberink, J. S.: Mathematical modelling of one-dimensional morphological changes in rivers with non-uniform sediment, Ph.D. thesis, Delft University, Delft, Netherlands, 1987.

Wilcock, P.R., Crowe, J.C., Surface-based transport model for mixed-size sediment, J.Hydraul. Eng., 129(2), 120– 128, 2003.